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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1276

The VELVET BEAN

THE VELVET BEAN is the most vigorous-growing annual legume cultivated in the United States.

With the discovery and introduction of early-maturing varieties the area planted to velvet beans in the United States has increased very greatly.

One or more varieties of velvet beans can be grown successfully in nearly all parts of the Cotton Belt. The Alabama variety now constitutes at least 80 per cent of the acreage.

As velvet beans are injured by cool weather, they should not be planted until the soil has become warm.

This crop is especially adapted to the well-drained portions of the Atlantic and Gulf Coastal Plain areas, and it is in these sections that the greatest acreage is to be found. Velvet beans will also make a fair to good growth on the heavy clay soils in the northern portion of the Cotton Belt.

The yield of velvet beans is not affected by the use of lime.

Velvet beans are usually planted with corn. They may be planted in the same row as the corn or in separate rows. Two rows of corn to one of beans is the most popular method of planting. The yield of corn may be decreased slightly by the beans, but the value of the beans for green-manure and feeding purposes will be much greater than the loss to the corn crop.

The most important use of the velvet bean is as a grazing crop for cattle and hogs in autumn and winter.

The velvet bean is the best annual-legume crop grown in the South for soil improvement.

On account of the extensive tangled growth of vines it is necessary to pick velvet beans by hand. From 25 to 50 cents per hundred pounds is paid for picking the beans.

The usual yield of velvet beans in the pods is from one-half to 1 ton per acre.

Velvet beans are excellent as part of the feed for beef cattle and dairy cows.

Feeding experiments show that 2 to 2½ pounds of velvet beans in the pod are equal to 1 pound of high-grade cotton-seed meal.

THE VELVET BEAN.[1]

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VELVET BEANS have become a most important factor in developing the live-stock industry in the South and as a rotation crop which helps the succeeding crops. The velvet bean is a summer-growing annual legume which produces a large quantity of seed, and because the feeding value of the vines, leaves, and seed is not seriously injured by exposure in the field during winter, the crop is of great value for grazing from late fall until early spring. The beans have high feeding value and so are of importance as a concentrated feed. Silage made by mixing the velvet bean with corn is a much better feed than silage made from corn alone. For a fertilizing crop the velvet bean is of greater value than the cowpea, as it makes a much heavier growth and is less expensive.

The velvet bean first came into notice as a forage and fertilizing crop about 1890, at which time its cultivation was confined, on account of its lateness, almost wholly to Florida. With the introduction and development of earlier ripening varieties its culture has now been extended northward to Virginia and Tennessee.

DESCRIPTION.

The velvet bean is the most vigorous-growing annual legume cultivated in the United States, the vines often reaching a length of more

[1] This bulletin is a revision and extension of Farmers' Bulletin 962, entitled "Velvet Beans," by S. M. Tracy and H. S. Coe, issued in 1918.

than 50 feet. (Fig. 1.) The leaves are petioled and trifoliolate. The membranous leaflets, which are shorter than the petiole, are from 3 to 10 inches long and about two-thirds as broad, the terminal one being rhomboid-ovate and the lateral ones obliquely so. The flowers of the different varieties, which vary in color from white to dark purple, are 1 to 1½ inches long and are borne singly or in twos or threes in long pendent clusters.

FIG. 1.—A young plant of velvet bean.

Velvet-bean pods are of two distinct types, one being covered with a dense, black, velvety pubescence, as in the Florida and Alabama varieties, while in the other type the pubescence consists mostly of short white or grayish hairs, as in the Lyon and Chinese varieties. In all kinds the pods are covered with more or less numerous short bristles which cause a slight irritation of the skin. Much of this pubescence falls off soon after maturity. The pods of some varieties are only 2 to 3 inches long, while those of others may reach a length of 5 to 6 inches. The seeds vary from nearly white to marbled brown, brown, and black. Varieties which commonly produce marbled seeds may produce occasionally an entirely white or an entirely colored seed.

Velvet beans have numerous rather fleshy surface roots, which are often 20 to 30 feet long and abundantly supplied with nodules varying from one-fourth to 1½ inches in diameter. The plants are rarely attacked by root-knot and are immune to wilt.

HISTORY.

While the Florida velvet bean has been grown for more than 40 years as an ornamental vine for porches and trellises, its value as a soil-improving crop or as a forage crop was not recognized until rather recently. As early as 1890 this plant was used to some extent for green manure in citrus orchards in Florida. From that time until the present the acreage has increased rapidly, and the crop now occupies an important place in southern farming systems.

The Florida velvet bean was the only one grown for forage in the United States until about 1906, but during recent years the Department of Agriculture has introduced about 20 other species, including the Chinese, Lyon, and Yokohama varieties, which have become more or less extensively cultivated.

According to present information the first early-maturing variety of velvet beans was discovered in August, 1906, on a farm operated by Clyde Chapman, at Sumner, Ga. At this time several mature plants were found in a field planted to corn and Florida velvet beans. The seeds of these plants were saved and planted in corn the following year. The plants produced were similar in every respect to those found the previous year. In 1908 seed of this variety was distributed to some of Mr. Chapman's neighbors, but only a small quantity of it was sent out of his immediate neighborhood prior to 1912.

An early-maturing variety which resembled in every respect the one discovered by Mr. Chapman was found in August, 1908, in a field planted to corn and Florida velvet beans on a farm operated by R. W. Miller, at Broxton, Ga. The early-maturing plants found by Mr. Chapman and Mr. Miller have been named the Georgia velvet bean.

Another early-maturing velvet bean was discovered in 1911 by H. L. Blount, at Flomaton, Ala. This variety, now known as the Alabama was found in a field planted to corn and Florida velvet beans. It is a more vigorous and later variety than the Georgia, but it matures considerably earlier than the original variety. The Georgia velvet bean was also called Hundred-Day Speckled, Ninety-Day Speckled, and Early Speckled, but the same names were later transferred to the Alabama variety.

It is very probable that early-maturing velvet beans were also found by other people and that they were present but unobserved in other fields. There is no doubt that the Georgia, Alabama, and many early-ripening varieties are simply early-ripening kinds of the Florida velvet bean.

VARIETIES.

There are now many varieties of the velvet bean grown in the United States. These differ from each other principally in growth

of vine; color of flowers; size, shape, and pubescence of the pods; size, shape, and color of the seeds; and in the length of time required to mature. While these varieties vary greatly in many ways, the common name velvet bean is applied to all.

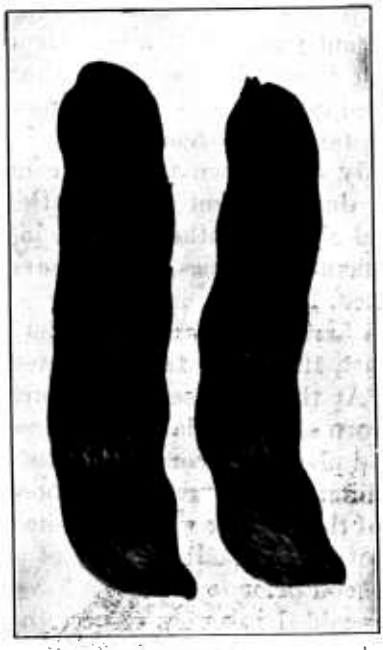

FIG. 2.—Mature pods of the Florida velvet bean. (Natural size.)

THE FLORIDA VELVET BEAN.

The Florida velvet bean makes a very rank growth of vine and requires a season of eight or nine months without frost to mature. The purple flowers are borne in clusters usually 3 to 8 inches long, and the pods, which are 2 to 3 inches in length, are nearly straight, blunt at each end, and covered with a black velvety pubescence. (Fig. 2.) The seeds are nearly spherical, about three-eighths of an inch in diameter, and usually grayish, marbled with brown. (Fig. 3.) White seeds are produced occasionally, and a white-seeded variety has been isolated, but this variety has shown no special superiority over the one with mottled seeds.

THE GEORGIA VELVET BEAN.

The Georgia velvet bean is a very early sport of the Florida velvet bean. (Fig. 4.) It makes a much less vigorous growth and yields somewhat less seed to the acre than the original Florida variety, but otherwise it is practically the same. The plant matures in 110 to 130 days and is adapted to all parts of the Cotton Belt.

This variety was much grown for a few years, but proved inferior to the somewhat later Alabama.

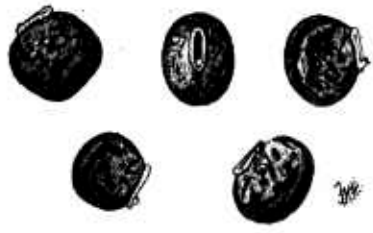

FIG. 3.—Seeds of the Florida velvet bean. (Natural size.)

THE ALABAMA VELVET BEAN.

The Alabama velvet bean is very similar to the Georgia variety, except that it makes a more vigorous growth and matures about six weeks later. It is best adapted to the country south of central Georgia, central Alabama, and central Mississippi.

The Alabama is now the principal variety cultivated, having replaced the Georgia almost entirely, but often under the names Early Speckled or Hundred-Day Speckled.

THE OSCEOLA VELVET BEAN.

The Osceola velvet bean is a hybrid between the Florida and the Lyon varieties developed at the Florida Agricultural Experiment Station. The white or rarely purple flowers of this vigorous-growing plant are borne in rather short racemes. The pods are 4 to 5 inches in length, flat, ridged lengthwise, covered with a black velvety pubescence, and bear from four to six, usually five, seeds. (Fig. 5.) The seeds are slightly larger than those of the Lyon or Yokohama varieties and usually are marbled with brown, although occasionally white seeds are produced. (Fig. 6.) The pods are nearly free from stinging hairs. This plant matures in 150 to 160 days and is therefore earlier than the Florida and later than the Alabama and Yokohama sorts. It is adapted to the country south of a line running through the center of the States of Georgia, Alabama, and Mississippi. This midseason-maturing variety yields heavily, but the pods are more woody than those of the Alabama.

FIG. 4.—A well-developed raceme of the Georgia velvet bean. (One-half natural size.)

THE LYON VELVET BEAN.

The Lyon velvet bean was introduced in 1907, the first specimens being obtained from Pampanga Province, Luzon, Philippine Islands. This plant makes a vigorous growth of vine and requires a long season to mature, seldom ripening more than 10 days earlier than the Florida bean. The white flowers are borne in pendent racemes which often reach a length of 2 to 3 feet. The woody pods are 5 to 6 inches long, compressed, ridged lengthwise, and covered with a fine grayish pubescence. (Fig. 7.) They have a tendency to split open and shatter the seeds when still in the field. The ash-colored seeds are similar in size and shape to seeds of the Lima bean. (Fig. 8.)

FIG. 5.—Mature pods of the Osceola velvet bean. (Natural size.)

THE CHINESE VELVET BEAN.

The Chinese velvet bean was introduced from Tehwa, China, in 1909. In nearly all respects this variety is like the Lyon, but does not make as vigorous a growth. It ripens about six weeks earlier than either the Lyon or the Florida variety. For this reason it will mature much farther north. It usually ripens before frost south of central Georgia, central Alabama, and central Mississippi.

THE YOKOHAMA VELVET BEAN.

The Yokohama velvet bean was obtained from Yokohama, Japan, in 1909. This plant produces a smaller vine growth than any of the

other species and is not a heavy yielder. It is an early-maturing species, requiring 110 to 120 days to ripen. It will ripen before frost in the Atlantic Coast States south of Washington, D. C. The purple flowers are borne in short racemes. The pods are 4 to 6 inches long, flat, quite pointed at each end, and covered with a rather long gray pubescence. (Fig. 7.) The seeds are ash colored, oblong, compressed, and about two-thirds of an inch long. (Fig. 9.)

This species has several undesirable characters. Many of the pods form so close to the ground that they become water-soaked with each heavy rain, causing many to decay; also the pods split readily and shatter the seed in hot, dry weather.

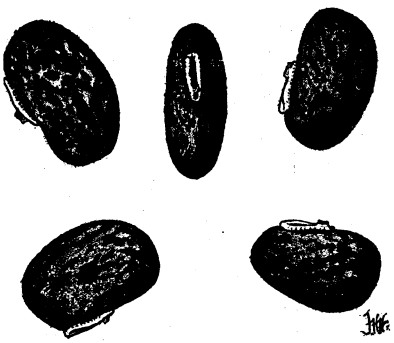

FIG. 6.—Seeds of the Osceola velvet bean. (Natural size.)

THE BUSH OR BUNCH VELVET BEAN.

This is a nontwining variety of velvet bean, a sport of the Florida, which first developed as a single plant on the farm of Roan Beaseley at Kite, Ga. The seeds were saved and the sport was found to breed true to type. An individual plant is about 3 feet high, branched near the base, most of the branches short, but an occasional one 5 to 7 feet long. These long branches show no tendency to twine. The pod clusters are formed in a dense mass near the base. The variety matures at about the same time as the Alabama, but the yield is less.

The Bunch variety has become very popular as a green-manure crop in orchards. It is also grown quite largely in corn, as the plants do not vine and weight down the corn as do the twining sorts. The main objections to this variety are that the pods can not be gathered as rapidly as those of the twining varieties, and they lie so close to the ground that they become water-soaked in wet weather, causing many of them to decay.

MISCELLANEOUS HYBRIDS.

Many hybrid velvet beans have been developed by the Florida Agricultural Experiment Station and by the Office of Forage-Crop Investigations of the Bureau of Plant Industry. Some of these were named and distributed, but none have been grown to any considerable extent with the exception of the Osceola, which became rather popular. All of the species except the Florida have rather woody pods and shatter very readily, characters which are not considered

desirable. These same traits appear in most of the hybrids and have prevented their becoming popular.

DISTRIBUTION.

The Florida velvet bean seldom matures more than a few pods if grown north of the extreme southern portions of Georgia, Alabama, and Mississippi, but with the introduction or development of early-

FIG. 7.—Pod of the Lyon velvet bean on the left and of the Yokohama velvet bean on the right. (Natural size.)

maturing types the area to which this crop is adapted has been gradually extended northward until it now comprises nearly the entire Cotton Belt. (See Fig. 10.) Most of the varieties, and especially the Alabama and Yokohama, will make considerable growth as far north

as the Ohio River, but when the velvet bean is planted north of the southern boundary of Tennessee in the Piedmont section and north of southeastern Virginia in the Coastal Plain area it should be planted primarily as a green-manure crop, for only in years with favorable growing seasons and late fall frosts will many pods mature. As the Florida variety has been grown for a long time in the southern portion of the Gulf States as a grazing and green-manure crop, it was only natural that the farmers in sections where it failed to mature fully should be the first to take advantage of newly introduced and early-maturing varieties which promised to give better results. There are other reasons which contributed to the rapidly increased acreage of velvet beans in the Gulf States, the most important of which was the serious damage done by the cotton-boll weevil in recent years, making it necessary to change the methods of farming.

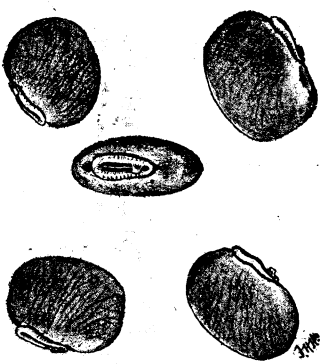

FIG. 8.—Seeds of the Lyon velvet bean. (Natural size.)

EXTENT OF CULTURE.

The extent of culture of velvet beans and the rapidity with which it increased are well shown in Table 1. Until the early varieties were obtained, the crop was grown mainly in Florida and probably never exceeded 700,000 acres in any one year. The whole story of the velvet bean is one of the most striking romances of American agriculture.

TABLE 1.—*Area and production of velvet beans, 1919 to 1921, inclusive.*[1]

State.	1919		1920		1921	
	Acres.	*Tons.*	*Acres.*	*Tons.*	*Acres.*	*Tons.*
North Carolina	55,000	44,000	60,000	51,000	74,000	55,500
South Carolina	90,000	45,000	150,000	75,000	250,000	125,000
Georgia	750,000	153,965	450,000	155,053	780,000	436,000
Florida	250,000	160,000	240,000	184,000	252,000	150,000
Alabama	750,000	485,000	750,000	676,000	838,000	1,035,000
Mississippi	189,000	150,000	290,000	203,000	300,000	120,000
Louisiana	125,000	178,848	173,000	179,820	254,000	182,250
Texas	4,000	.....	4,000	.....	4,000	.....
Arkansas	4,000	.....	5,000	.....	6,000	.....
Total	2,217,000	1,216,813	2,422,000	1,523,873	2,758,000	2,153,750

[1] These figures were compiled by the Bureau of Markets and Crop Estimates, United States Department of Agriculture, and represent tentative estimates submitted in December, 1921.

SOIL PREFERENCES.

Velvet beans are especially adapted to the well-drained portions of the Atlantic and Gulf Coastal Plain areas. The soils of this area are in general sandy in texture, and the quantity of fertilizers used

per acre is greater than in any other part of the United States. In this section, where the greatest acreage is to be found, the velvet bean will make a profitable growth on newly cleared land and also on soil that has been under cultivation for a long time. In many places it is used extensively on cut-over pineland and on sandy soils as a green-manure crop, as it has been found that it will produce more vegetable matter under such conditions than any other annual legume grown at the present time.

Velvet beans also make a good growth on the clay soils in the northern portion of the Cotton Belt, but on the poorer soils in this area it is questionable whether they will do better than cowpeas. Velvet beans will not succeed on cold, wet soils and should never be planted before the soil has become warm.

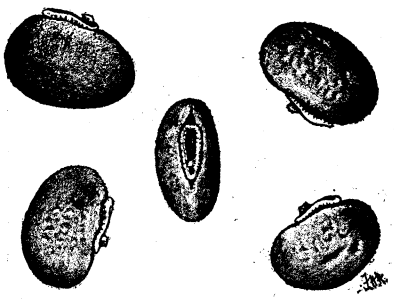

FIG. 9.—Seeds of the Yokohama velvet bean. (Natural size.)

FERTILIZERS.

Even though velvet beans make a fair growth on poor soils, some farmers in some sections make a small application of fertilizer at the time of seeding. Where it is used, the mixture and quantity are about the same as for corn.

Velvet beans, through the nodules on their roots, are able to obtain nitrogen from the atmosphere, and most of this nitrogen is returned to the land when only the pods are picked or when the crop is pastured and the roots and uneaten portions of the plants decay.

At the agricultural experiment station at McNeill, Miss., phosphatic fertilizers are necessary to obtain good yields, and 100 to 200 pounds per acre are recommended on the basis of experimental results. Cottonseed meal at the rate of 200 pounds per acre gave an added yield of 280 pounds of beans per acre as compared with the use of 200 pounds per acre of acid phosphate alone. The further addition of 200 pounds of kainit gave no increased yield. At the Florida Agricultural Experiment Station no increased yield was obtained from fertilizers applied singly or in various mixtures.

INOCULATION.

Apparently all of the velvet-bean area is provided with the organism that forms nodules on velvet-bean roots. No lack of root nodules seems to occur when velvet beans are planted on land for the first time, but instances have been noted where the growth of the vines has been materially increased by inoculation.

Experiments conducted by the Office of Soil-Bacteriology Investigations of the Bureau of Plant Industry prove that the same strain of organism that inoculates Lima beans, cowpeas, and lespedeza (or Japan clover) also inoculates velvet beans. As lespedeza grows abundantly over most of the South and as cowpeas have been planted widely for many years in all the velvet-bean regions, it is easy to understand why the velvet bean has succeeded so well without artificial inoculation. The large acreage of velvet beans planted during recent years has served also to increase its inoculating organisms.

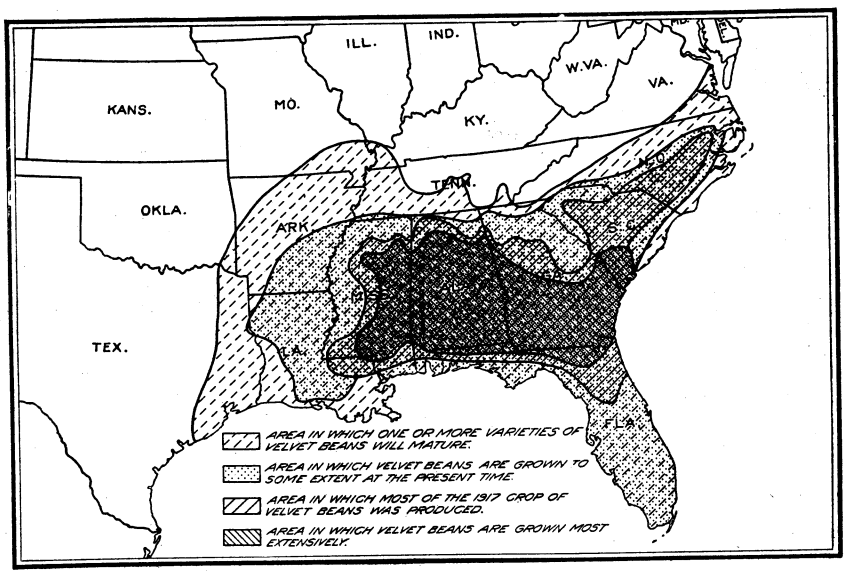

FIG. 10.—Map of the southeastern United States, showing the distribution of velvet beans.

TIME OF PLANTING.

Velvet beans will not germinate well in cold or wet soil, and the young plants are very susceptible to injury by frost. On this account they should not be planted until all danger of frost is past, or about cotton-planting time. However, when late-maturing varieties are used it is necessary to plant the seed as soon as the soil is in good condition, so that the plants will have as much time as possible to mature before frost. With early-maturing varieties the date of planting may extend over a period of six weeks or two months in the southern portion of the Gulf States. When early varieties are used in the northern part of the Cotton Belt it is necessary to plant the seed early, or at corn-planting time. In the Coastal Plain section of the Gulf States the early planting of early-maturing varieties has been found undesirable by some farmers, as the beans mature so early that the pods will split and shatter the seed to a

certain extent, and the foliage will shed before the corn is gathered or the animals can be turned into the field. When the crop is to be pastured, many farmers prefer to have the beans frosted before all of the pods are matured rather than to have them mature too early. As most of the beans are grown with corn, it is better in many cases to grow varieties which can be planted with the corn and which will mature at the desired time.

Growers of velvet beans do not agree as to the best time to plant the beans in the corn. In some sections it is the common practice to plant the corn and beans at the same time, while in other sections the beans are planted some weeks later than the corn. The method of planting the two crops, the variety of beans used, and the labor available should determine this matter. When late-maturing varieties are to be grown, it is necessary to plant them at the same time as the corn, but when early-maturing varieties are used, and especially in the southern portion of the Cotton Belt, it is best to plant the corn some time before the beans. Where sufficient labor is available, the beans may be planted at a later date by hand in the rows of corn. On the richer soils the method of planting two rows of corn and one row of beans is used extensively, and when an early variety of velvet bean is used in this way it may be planted later with no extra expense. However, on the poorer soils, where velvet beans should be planted in every row of corn, it is a saving of labor to use a planter which will place both kinds of seeds in the same row and at the same operation. (See Fig. 11.) The length of the growing season for an average year can be approximately determined from the frost lines shown in Figure 12, and this, together with the time required for the different types to mature, should give an idea as to the best time of planting.

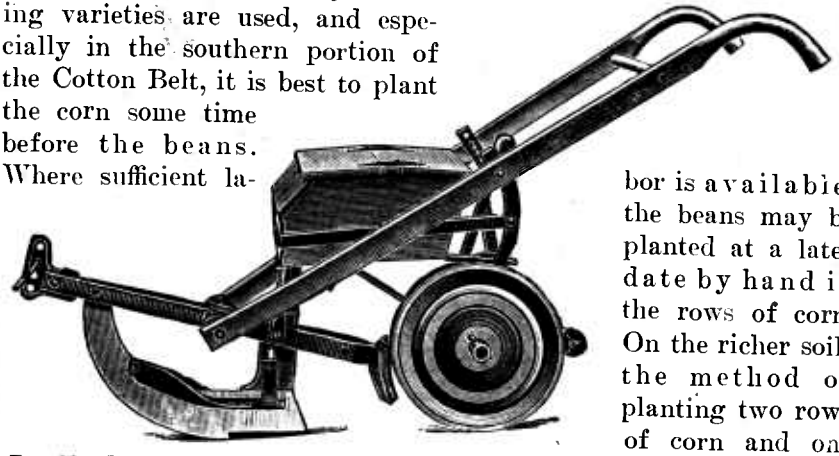

FIG. 11.—Planter used for planting corn and velvet beans in the same row at the same operation.

The length of time required for the ripening of any variety will vary greatly according to the time of planting. Velvet beans grow well only when the weather is warm, and they make little progress when the soil and air are cold or even moderately cool. The warmer the weather when the seed is planted the more rapid will be the growth of the plants.

METHODS OF PLANTING.

Velvet beans should be planted with some supporting crop, and corn answers this purpose very well. (Fig. 13.) Probably 90 per cent of the acreage is planted with corn. In 1913 the Florida Agricultural Experiment Station planted the Chinese beans in 4-foot rows without a supporting crop and in alternate rows with sorghum. The average yield of 3 acres planted alone was 23.2 bushels of hulled beans per acre, while the 1 acre planted in alternate rows with sorghum produced 26.9 bushels of hulled seed. In 1916 the Georgia Agricultural Experiment Station conducted similar tests and found that the yield of beans was increased when no supporting crop was used. Pearl millet, Japanese sugar cane, and other strong-growing plants also

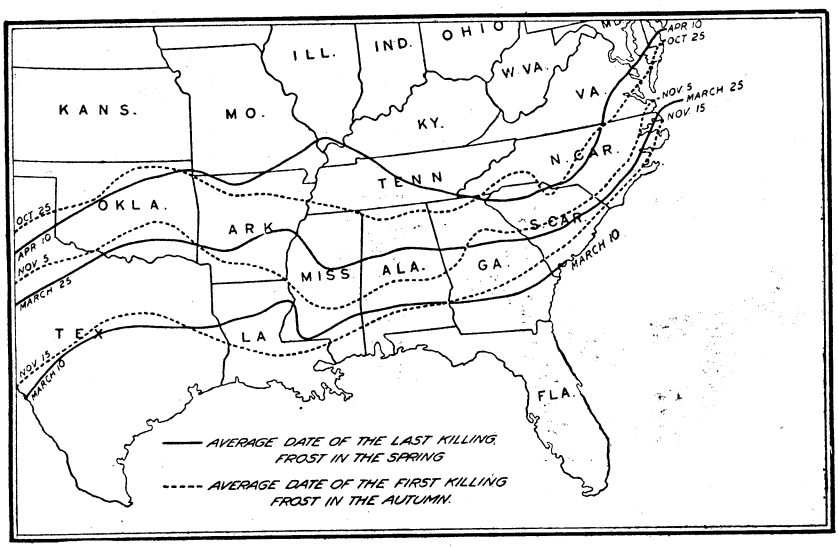

FIG. 12.—Map of the southeastern United States, showing the average dates of the last killing frost in the spring and the first killing frost in the autumn. The three sets of lines represent the approximate northern limit of the late, medium-early, and early maturing varieties of velvet beans.

are used for this purpose, but as corn is an important crop in the area to which the velvet bean is adapted it is generally preferred.

It is the consensus of opinion that the yield of corn is slightly decreased by the beans, but this will depend largely upon the rate and date of planting the beans and upon the richness of the soil. When corn is planted several weeks earlier than the beans it is not likely to be damaged, as the vines will not make sufficient growth to pull it down before the ears are nearly mature. However, when late-maturing varieties are planted on fairly rich soil at the same time as corn, the yield of corn will undoubtedly be decreased, as some of the corn will be pulled down and will probably mold. Even

though the yield is decreased the value of the beans for green manure or feeding purposes will be much greater than the loss to the corn crop. The cost of picking the corn is higher when velvet beans are planted with it than when planted alone. The increased cost is estimated by farmers who have had much experience with these crops at 5 cents per bushel. Several methods of planting corn and velvet beans are now in general use, and any one of these will give good results when carefully followed.

When the beans are planted by hand they should be dropped 18 to 24 inches apart in the row on poor soil and about twice that dis-

FIG. 13.—A field of corn and velvet beans in which the beans were planted in every row of corn.

tance apart on rich soil. This method should be followed when the corn is to be cut for silage or where the soil is poor and the vines will not make a vigorous growth.

The planting of corn and beans in separate rows is a popular method, and especially that of planting every third row to beans. (Fig. 14.) When this method is used, the beans may be planted at the same time as the corn or at a later date, as the cultivation of the corn will not interfere with the planting and cultivation of the beans. Even though the beans are planted at the same time as the corn, the corn will have an opportunity to make considerable growth before

the bean vines are grown sufficiently to twine about the stalks. In addition to this advantage, the gathering of the corn is made easier, as the vines do not make much growth between the two adjacent rows of corn, where the person who does the gathering may walk without difficulty. However, when the beans are planted in every row or in every other row, the vines are likely to form such a tangled mass that it will be more difficult to gather the corn.

Many farmers who feed hogs extensively plant alternate rows of peanuts and corn, with velvet beans in the corn rows. The entire crop is then pastured. On land where peanuts do well this combina-

FIG. 14.—Corn and velvet beans planted in separate rows. This method of planting gives the corn an opportunity to become well established before the beans have made sufficient growth to twine around the stalks.

tion yields an abundance of feed of a well-balanced ration and will produce a better quality of pork than a feed of either peanuts or velvet beans without the corn.

RATE OF SEEDING.

The rate of seeding will vary with the purpose for which the crop is grown and the variety used. When beans are planted with corn and it is desired to secure as much corn as possible, the beans should not be planted so closely as to interfere with its growth, and from 2

to 3 quarts per acre will be sufficient; while if a heavy crop of beans is wanted and the corn is not of first importance, twice as much seed should be used. These quantities are for the small-seeded sorts, like the Florida and Alabama, while for the larger seeded sorts, like the Chinese and Osceola, the quantities should be nearly doubled. When planted to make the heaviest possible quantity of vines, either for green manuring or as a smothering crop, from half a bushel to a bushel of seed should be used.

USES OF VELVET BEANS.

The vigorous growth of velvet beans, together with their large yield of seed, which may be gathered or allowed to remain in the field without much injury during the autumn and winter, permits this crop to be utilized in a number of different ways. As an annual green-manure crop it is unexcelled. Its value as a feed for stock is now generally recognized in the South, where large quantities are used for this purpose. The use of the beans ground in the pod has become large. The value of velvet beans as a winter pasture, either for carrying cattle through the winter or for fattening them, is now well established. With an increase of cattle it is very probable that the use of this crop for winter grazing will replace to a large extent the picking of the beans for grinding, as feeding experiments indicate that but little benefit is derived from grinding the beans for cattle. The crop may be utilized also for silage, hay, and as green manure.

HAY.

Velvet beans are seldom used for hay, as the vines become so long and tangled that it is very difficult to handle them. When used for this purpose it is necessary to cut the vines before many of the pods mature in order to save the leaves, which shatter rapidly from this time until maturity. The hay is rough and coarse at best and is not relished by horses and mules. Yields of 2 to 3 tons per acre may be obtained.

SMOTHERING CROP.

When late-maturing varieties of velvet beans are planted without a supporting crop they produce such a dense growth of vines that weeds, persistent grasses, and in many cases tree sprouts are smothered out. The Florida Agricultural Experiment Station planted a freshly plowed field of strong Bermuda grass to velvet beans in 1898. In 1899 this field was planted to cassava, during which time it remained entirely free from Bermuda grass, and again in 1900 when planted to a cultivated crop no trace of Bermuda grass was found. When velvet beans are planted as a smothering crop on new land, they should be sown broadcast, but when on old grass-

land it is best to plant them in rows, so that at least one cultivation may be given before the vines begin to run. In either case 2 to 4 pecks of seed should be used to the acre.

CORN AND VELVET-BEAN SILAGE.

Velvet beans have been employed to some extent in the making of silage, and for this purpose early-maturing varieties are commonly used. With such a variety most of the vine growth is wrapped about the cornstalks, and little trouble is experienced in cutting the corn with corn knives and in running it through the silage cutter. Silage made from this mixture turns black after it has been in the silo for a short time, on account of the juices in the velvet-bean plants, but this apparently does not impair its keeping qualities or feeding value. Stock eat silage made from this mixture as readily as that made from corn alone. Dairymen who have used this mixture speak of it highly and prefer it to silage made from corn or sorghum alone.

Table 2 gives an analysis of a sample of corn and velvet-bean silage compared with the average of a large number of samples of corn silage.

TABLE 2.—*Analysis of corn and velvet-bean silage as compared with silage made from well-matured corn.*

Kind of silage.	Number of analyses.	Constituents (per cent).					
		Water.	Ash.	Crude protein.	Carbohydrates.		Fat.
					Crude fiber.	Nitrogen-free extract.	
Corn and velvet beans [1]	1	73.7	1.0	3.5	5.5	15.6	0.7
Corn (well matured) [2]	121	73.7	1.7	2.1	6.3	15.4	.8

[1] Analyzed by the Bureau of Chemistry, U. S. Department of Agriculture.
[2] Analyses compiled by Henry and Morrison.

GRAZING.

The most important use of the velvet bean is as a grazing crop for cattle and hogs in the autumn and winter. It is not grazed well by horses and mules or by any animals until after it has been well matured or frosted. As the leaves, vines, and pods do not decay readily on sandy soils, velvet beans will often furnish feed until early spring. It is usually better to let the crop stand until it is well matured or until it is killed by frost, as the leaves will be off the plants at that time and the corn may be gathered with less difficulty. The beans needed for seed should be gathered before stock is turned into the field. The amount of grazing which will

be afforded will, of course, vary with the growth of the crop and the quantity of corn which is not gathered, but it is the custom with many cattlemen to allow one-third to one-half acre per month for each steer or cow. The usual period for pasturing velvet beans is about three months, but this may be shortened or lengthened as deemed advisable. When the acreage of beans is large and there are not sufficient cattle to stock the pasture at this rate, the grazing is often continued for four or five months, but when this is done there is necessarily some loss of feed through decay. Hogs should be permitted to follow the cattle, as they will consume practically all of the beans which have been broken from the plants and wasted by the cattle. A common practice is to allow one or two hogs in addition to the cattle for each acre of beans.

On the heavier soils of the South there is some danger of packing the soil to the detriment of the succeeding crop if grazing is continued in rainy weather. On this account pasturing on such soils should be done with more care than on sandy lands.

A good stand of velvet beans should produce about 200 pounds of beef and 100 pounds of pork per acre.

GREEN-MANURE CROP.

The velvet bean is one of our best soil-improving crops, both for soils which are naturally poor and for those on which yields have decreased markedly. The ability of this plant to make a profitable growth on land so poor that most legumes will not thrive places it among the most important crops for the South. In addition to adding at a minimum cost large quantities of vegetable matter to the soil, thus making it more retentive of moisture, the nodules on the roots collect a large amount of nitrogen from the atmosphere. This nitrogen will be left in the soil when the crop is turned under and the plants decay. Even though the crop is grazed, the nitrogen and humus content of the soil will be gradually increased, as much of the nitrogen in the portions of the plants consumed by the stock will be voided.

In many sections velvet beans have proved to be the most profitable crop to plant for one or two years on newly cleared land. In addition to producing sufficient grazing or feed during this time to more than pay the cost of planting and harvesting, the land will be so improved that other crops may be grown more successfully. The yield of seed from such ground is usually heavier than from fields which have been long in cultivation.

Investigations by the Alabama, Louisiana, and Florida Agricultural Experiment Stations give definite data regarding the quantities of material added to soil by velvet beans. These are shown in

Table 3. In interpreting this table it is well to remember that a ton of cottonseed meal contains about 130 pounds of nitrogen.

TABLE 3.—*Weights of dried and green material, roots, and nitrogen from an acre of velvet beans.*

Character of addition to soil.	Alabama.	Louisiana.	Florida.
	Pounds.	*Pounds.*	*Pounds.*
Green material	19,040	22,919	21,132
Dry material	8,240	7,495	5,953
Dried roots	1,258	191	690
Nitrogen in vines	201.3	170	131.5
Nitrogen in roots	12.6	2.9	9.7
Total nitrogen in crop	213.9	172.9	141.2

CONTINUOUS CROPPING.

The Florida Agricultural Experiment Station has conducted an experiment to determine the effect upon the yield of velvet beans when grown on the same plat of ground continuously for a number of years. While it is stated that there was no noticeable difference in the growth of the plants from year to year between the continuously planted plat and the check, the yields of seed secured from the continuously planted plat showed a marked decrease. The results obtained are shown in Table 4.

TABLE 4.—*Effect of continuous planting upon the yield of velvet beans at the Florida Agricultural Experiment Station, 1907 to 1912, inclusive.*

Year.	Yield per acre of shelled beans (bushels).		Year.	Yield per acre of shelled beans (bushels).	
	Continuously planted plat.	Check plat.		Continuously planted plat.	Check plat.
1907	25	21	1911	(1)	(1)
1908	15	23	1912	10	20
1909	11	28			
1910	14	22	Average	15	23

[1] Destroyed by caterpillars.

As will be seen by Table 4, the average yield for five years on the continuously planted plat was 8 bushels per acre less than that of the check plat. Experiments at Biloxi, Miss., showed similar results after three successive plantings.

It is much better to plant some nonleguminous crop after velvet beans have been grown for one or two years, and this can be done by adopting a rotation that will include the desired acreage of corn and beans. Where early-maturing varieties are planted in corn and the crop is pastured closely, the yield may not be decreased for several years, but this practice is not as desirable as rotation.

EFFECT OF VELVET BEANS ON SUCCEEDING CROPS.

Many experiments have been conducted to determine the effect of velvet beans on the next crop in a rotation, and nearly all indicate highly beneficial results.

At the Alabama Agricultural Experiment Station the seed-cotton yield per acre after cotton was 918 pounds; after velvet beans cut for hay, 1,126 pounds; after velvet beans plowed under, 1,578 pounds. Corn was planted on these plats the following year. That which yielded 918 pounds of cotton gave 18 bushels of corn, while the plat that produced 1,578 pounds of cotton yielded 25.5 bushels of corn.

At the Arkansas Agricultural Experiment Station the seed-cotton yield per acre after cowpeas plowed under was 1,355 pounds; after soy beans plowed under, 1,488 pounds; after velvet beans plowed under, 1,550 pounds.

At the Alabama Agricultural Experiment Station the yield per acre of corn after corn was 13.5 bushels; after velvet-bean stubble, 17.9 bushels; after velvet beans plowed under, 25.9 bushels. The velvet beans were planted after oat stubble was plowed under.

Various other similar experiments all point to the highly beneficial effect of velvet beans on succeeding crops.

HARVESTING.

On account of the extensive tangled growth of the vines of velvet beans it is necessary to pick the pods by hand. The cost of picking varies in different sections. In the past the cost has ranged from 25 to 50 cents per 100 pounds.

The price paid for picking also differs with the variety grown, the large-podded, large-seeded sorts being picked much faster because they produce larger and heavier bunches than types like the Georgia. Many laborers prefer to pick the large sorts, such as the Chinese and Osceola, in preference to the Florida, even when 10 to 15 cents less per 100 pounds is paid. For the average laborer, 500 to 700 pounds of beans in the pod constitute a day's picking. Very seldom is the entire crop gathered, for pickers are often careless and at best miss many pods. On this account animals should be turned into the field after the pickers have finished, in order to consume the vines and the beans not gathered.

Velvet beans should not be gathered until the pods are thoroughly ripe and dry. When immature pods or pods which are damp are picked they will heat and mold when stored in bulk unless thoroughly stirred at frequent intervals. Many mills will not purchase beans that are not dry, and those which do buy them pay much less than they would give for beans in good condition.

Many factors, including the quality of the soil, cultivation, and weather conditions, influence the yield of seed. It is estimated that

the average yield of the total acreage planted in corn in 1917 was about 1,000 pounds of beans in the pod per acre. On fairly rich soil the early-maturing varieties should produce 1,500 pounds per acre and the late-maturing varieties 2,000 pounds, while 1½ tons per acre is not an unusual yield. The Mississippi Agricultural Experiment Station obtained 4,400 pounds per acre at McNeill, and still heavier yields have been obtained from small areas which have been given special care.

One ton of pods will produce 20 to 22 bushels of shelled beans, the quantity depending on the variety and the amount of moisture in the pods. With varieties like the Alabama and Florida, 90 to 95 pounds of pods will usually thrash out a bushel (60 pounds) of shelled beans, while larger and coarser podded sorts, like the Chinese and Yokohama, require approximately 100 pounds of pods to produce a bushel of shelled beans.

THRASHING.

When velvet beans are to be fed to cattle or ground into meal it is not necessary to hull them; in fact, it is preferable to feed both hulls and beans to cattle, as the hulls have a little feeding value. For this reason the quantity of beans thrashed is ordinarily limited to those which are to be used or sold for seeding purposes. The beans may be thrashed with a flail or with one of the several thrashing machines now offered for sale. Regardless of the method of thrashing, only well-matured and thoroughly dried pods can be thrashed without difficulty. If only a few are to be hulled, they may be sunned a few hours, put in an ordinary corn sack, and beaten out with a club. When larger quantities are to be thrashed it is better to use one of the machines designed for the purpose. A small machine run by hand which has sufficient capacity to enable a man and a boy to thrash 10 to 15 bushels per day can be purchased for about $25. This machine has been used by gearing it to an automobile, and in that way about 50 bushels were thrashed in a day. A larger machine that requires a 2 to 4 horsepower engine and which will thrash 10 to 15 bushels per hour can be purchased for about $75. Larger machines equipped with cylinders and screens to pick peanuts or shell corn may be successfully used for thrashing velvet beans by making a few changes. Such machines, requiring an 8 to 12 horsepower engine to operate them, will thrash 60 to 70 bushels an hour.

In some sections farmers have bought machines cooperatively, or individuals have purchased machines and do community thrashing. Some of the grinding plants also have purchased thrashers and thrash for the public on a cash or toll basis. The price charged for thrashing varies from 15 to 30 cents per bushel of hulled beans.

When the beans are to be sold for seed or for grinding they should be thrashed whenever possible before being placed on the market. When sold in the pod they require so much storage room that the mills are able to care for only a small part of the crop, and of course they deduct the cost of storage and thrashing from the price paid the grower.

GRINDING.

Velvet-bean meal has become a standard feed for live stock and especially as the concentrated part of the many mixed feeds offered for sale on the market. In the manufacture of this meal the hard beans and tough pods are ground, or, rather, crushed together by machinery especially designed for handling such material. No standard of fineness for grinding meal has been established, but up to a very recent period most of it was ground so as to pass through sieves having meshes one-fifth to five-eighths of an inch in size. The trade is now demanding a finer ground meal, and many mills are grinding it as fine as corn meal. This finer meal is preferred for the manufacture of mixed feeds. It is impossible to grind velvet beans finely unless they are well matured and thoroughly dry. On this account some mills kiln-dry all beans before grinding. This adds considerably to the cost of manufacture, but it is necessary early in the season in order to prevent the meal from spoiling.

Velvet beans may be ground alone or with other feeds, but when ground alone the meal should be fed in combination with other feeds. A common mixture is obtained by grinding velvet beans and corn in the shuck together. In accordance with the use to be made of the feed, velvet-bean meal is used in varying proportions in the manufacture of mixed feed. In horse feeds it seldom forms more than 25 per cent of the entire mixture, while in mixed feeds for dairy cows it may run as high as 70 per cent. A popular mixed feed for dairy purposes is composed of 15 per cent cottonseed meal, 45 per cent corn-and-cob meal, and 40 per cent velvet-bean meal, while a popular horse feed contains in addition to the velvet-bean meal, corn, oats, and ground hay or straw.

In the manufacture of velvet-bean meal there is a loss of 10 to 20 per cent in the weight of the beans from the time of purchase until they are sacked and ready for the market. The loss occurs mostly in the drying kilns and varies considerably, depending on the condition of the beans when dried and the season. A loss of 15 per cent is not uncommon when the beans are dried early in the fall, but later in the season the loss is much less.

FEED.

No other crop so high in feeding value can be produced as cheaply or in such quantity on the soils of the South as the velvet bean. In

addition to the high feeding value and the low cost of production, this crop, unlike other legumes, may be permitted to remain in the field until late winter without serious injury, as the pods decay very slowly when subjected to weather conditions; in fact, the pods and beans are eaten more readily by live stock after they have softened.

Velvet beans may be pastured with cattle and hogs or the pods may be picked and fed to live stock either whole or after being ground. It is not necessary to grind the pods for home consumption, as practically as good results will be obtained from feeding them whole; but if the pods have been permitted to become dry it is better, although not absolutely necessary, to soak them before feeding. Feeders who have used velvet-bean meal and ground beans[2] find that a larger quantity of the former is needed to obtain the same results. It requires about 2½ pounds of velvet-bean meal or 1½ pounds of ground beans to equal in feeding value 1 pound of high-grade cottonseed meal.

TABLE 5.—*Composition of different varieties of velvet beans and of velvet-bean meal, compared with other feeds.*

Portion analyzed.	Number of analyses.	Constituents, moisture-free basis (per cent).				
		Ash.	Crude protein.	Carbohydrates.		Fat.
				Fiber.	Nitrogen-free extract.	
Florida velvet bean:[1]						
Shelled beans		3.2	27.7	6.8	55.9	6.4
Pods		6.0	5.9	31.7	55.6	.7
Pods and beans (meal)		3.8	20.1	14.9	56.6	4.6
Chinese velvet bean:[1]						
Shelled beans		3.4	27.7	6.4	57.8	4.7
Pods		5.0	5.5	28.1	60.5	.9
Pods and beans (meal)		4.5	21.0	15.6	56.3	2.6
Kind of feed:						
Velvet-bean meal[2]	5	4.5	20.3	16.5	54.5	4.4
Cottonseed meal (choice)[3]	2,556	6.7	47.7	8.8	27.0	9.8
Corn meal or chop[3]	5,335	1.5	10.5	2.6	81.1	4.3
Wheat bran[3]	7,742	7.0	17.8	10.7	59.6	4.9
Rice polish[3]	1,013	5.3	13.2	2.1	69.2	10.1
Velvet-bean hulls[2]	3	6.0	5.7	30.0	57.0	1.1
Cottonseed hulls[2]	66	2.9	5.1	48.5	41.3	2.1

[1] Analyses made by the Bureau of Chemistry, U. S. Department of Agriculture.
[2] Analyses compiled by the Office of Forage-Crop Investigations.
[3] Analyses taken from Henry and Morrison's "Feeds and Feeding," sixteenth edition.

As velvet beans are very high in digestible protein, great care should be exercised in feeding them to live stock, especially at first. After the stock become accustomed to the beans they should be kept in the field for only a short period each day until the crop is somewhat reduced, as excessive consumption is a waste of concentrated feed. In addition to wasting concentrated feed, overfeeding some-

[2] Much confusion has been caused by the use of the term "velvet-bean meal" in referring to the products of grinding. In this bulletin "velvet-bean meal" is used to designate the product of grinding the pods and beans together, and when the beans are ground alone they are referred to as "ground beans."

times has a laxative effect similar to that caused by feeding too much cottonseed meal. For these reasons and because better gains will be obtained, this crop should be fed in combination with other feeds. This is accomplished when cattle and hogs are pastured on corn and velvet beans, as some corn will be overlooked in picking and the stover contains a relatively high proportion of carbohydrates.

COMPOSITION.

Velvet beans contain high percentages of protein and carbohydrates, thus making them a source of these valuable constituents needed for growing stock and milk production. Table 5 shows the composition of the different varieties of velvet beans and of velvet-bean meal, compared with other feeds.

FEEDING VALUE.

The feeding experiments thus far conducted indicate that velvet beans and velvet-bean meal are excellent feed as part of the ration for beef cattle and dairy cows. The Mississippi Agricultural Experiment Station finds that as a partial ration velvet-bean meal is a good feed for work horses, brood mares, and mules. For swine the reports of results of feeding this meal are conflicting, many of them being unfavorable. In most cases, however, velvet-bean pasturage is very economical as a part feed for pigs and hogs. There are some indications that these beans cause abortion in brood sows, and while the evidence is not conclusive it is well to be cautious in such cases.

FEED FOR BEEF CATTLE.

The Florida Agricultural Experiment Station found velvet beans in the pod a very satisfactory feed for steers as part of the ration. The daily gains were higher and the cost of the gains much less than with any of the other rations compared with them, including one composed of corn, cottonseed meal, and hay.

In a later experiment 220 head of cattle were pastured on velvet beans for 28 days and then fed a ration consisting of sorghum silage, velvet beans in the pods, and cottonseed meal. The results were considered highly satisfactory.

At the Alabama Agricultural Experiment Station cottonseed meal was compared with velvet beans in the pod, each being fed with corn silage. In the two feeding tests it was found that from 2.05 to 2.46 pounds of velvet beans equaled 1 pound of high-grade cottonseed meal, measured both by gains and by quality of meat.

In a later trial 3.07 pounds of dry beans in the pods, 2.7 pounds of beans in the pods soaked in water, and 2.16 pounds of pods and beans ground into meal were each equal in feeding value to 1 pound of cottonseed meal.

In several tests carried on by the Animal Husbandry Division of the United States Department of Agriculture both dry and soaked velvet beans have given satisfactory results.

FEED FOR DAIRY COWS.

At the Florida Agricultural Experiment Station 816 pounds of velvet beans in the pods fed with wheat bran and Japanese cane silage produced 348.7 gallons of milk at a cost of 13.3 cents per gallon, while 576 pounds of cottonseed meal fed with wheat bran and more silage produced 352.5 gallons of milk at a cost of 16.5 cents per gallon. On this basis velvet beans in the pod are worth $2.37 when cottonseed meal is worth $2.40 per 100 pounds. In another test it was found that 267.75 pounds of velvet beans in the pods fed with bran and silage produced 934.6 pounds of milk, while 94.5 pounds of cottonseed meal fed with bran and less silage produced 937.1 pounds of milk.

From still later experiments it was concluded that when fed with bran and silage 2 pounds of velvet-bean meal were equal to 1 pound of cottonseed meal.

According to Prof. M. P. Jarnagin, the Georgia Agricultural Experiment Station found that 2,035 pounds of velvet-bean meal were equal to 2,000 pounds of cottonseed meal for milk production, and that 5½ pounds of velvet beans produced 1 pound of milk as against 5 pounds of cottonseed meal to produce the same quantity.

At the Alabama Agricultural Experiment Station, during an experiment of 56 days, 4 cows consumed 1,370.9 pounds of velvet beans, 913.9 pounds of corn, and 6,720 pounds of silage and produced 3,252.4 pounds of milk at a cost of $1.47 per 100 pounds; while 4 other cows consumed 678 pounds of cottonseed meal, 894 pounds of corn, and 6,700 pounds of silage and produced 3,418.1 pounds of milk at a cost of $1.33 per 100 pounds.

At the Tennessee Agricultural Experiment Station equal quantities of cottonseed meal and velvet-bean meal fed in no greater amount than 10 pounds a day proved good feed for dairy cattle. Of the velvet-bean meal 9 pounds were hardly equal in value to 6 pounds of the cottonseed meal.

The Massachusetts Agricultural Experiment Station made two experiments with groups of 6 and 4 cows, in which the ration consisted of hay and a grain ration of 20 per cent cottonseed meal, 40 per cent corn-feed meal, and 40 per cent velvet-bean feed or wheat bran. The results showed that the cows while receiving the velvet-bean ration produced 2.7 and 9 per cent with an average of 5 per cent more milk than while on the wheat-bran ration. It was concluded that the velvet-bean feed is somewhat superior to wheat bran for dairy purposes and that it may constitute as high as 40 per cent of a dairy ration, together with a like quantity of corn or hominy meal

or ground oats and some 20 per cent of cottonseed or linseed meal or other high-grade protein concentrate.

FEED FOR SWINE.

At the Florida Agricultural Experiment Station corn and cracked velvet beans in various proportions were compared with corn alone as feed for pigs. In all cases the pigs made more rapid and cheaper gains on the corn and velvet-bean mixture than on corn alone.

In another test at this station shelled corn and soaked velvet-bean feed were fed to three hogs, gradually increasing the proportion of velvet-bean feed from one-fourth to two-thirds by weight. The hogs made very satisfactory gains, and it was found that the feed produced a hard pork.

At the Massachusetts Agricultural Experiment Station a ration composed by weight of 20 parts of velvet-bean feed, 20 parts of high-grade peanut meal, 50 parts of corn meal, and 10 parts of alfalfa meal gave as satisfactory results as one composed of 80 parts corn meal and 10 parts each of digester tankage and alfalfa meal. The addition of 10 per cent of ground alfalfa to the grain ration for growing pigs, in order to supply the necessary vitamines, did not seem to exert any marked effect in promoting growth.

At the Alabama Agricultural Experiment Station various feeding experiments with swine have been conducted. In one test 5 pigs, averaging 62 pounds weight, were pastured on velvet beans for 72 days, receiving in addition a half ration of corn 4 parts and tankage 1 part. They gained 1.23 pounds a day, each requiring two-fifths of an acre of velvet beans and 170 pounds of corn and tankage to gain 100 pounds.

In another test pigs fed on corn meal alone gained 100 pounds at a cost of $8.64, while those fed on equal parts of corn meal and ground velvet beans gained 100 pounds at a cost of $9.37.

In a third test it was concluded that velvet-bean pasture reduced by one-third the cost of gains in comparison with corn 10 parts and dried blood 1 part.

In a test made by the United States Department of Agriculture at the experiment farm at Beltsville, Md., in 1918, pigs fed soaked whole velvet beans and shelled corn made an average daily gain of 0.586 pound. Pigs fed soaked ground velvet beans alone made an average daily gain of 0.417 pound, and pigs fed soaked ground velvet beans, shelled corn, and fish meal made an average gain of 1.15 pounds.

With corn costing $1.92 a bushel, fish meal $100 a ton, and velvet beans $36 a ton, the feed cost per pound of gain was 18.3, 23, and 14.3 cents, respectively. Observations during the test indicated that hogs did not like the taste of the beans.

At the Kentucky, Michigan, and Arkansas Agricultural Experiment Stations the results from the use of velvet-bean meal as a part ration did not compare favorably with the other rations tested.

FEED FOR HORSES

The Mississippi Agricultural Experiment Station reports that velvet-bean meal mixed with corn or other grain is a satisfactory feed for horses.

In feeding tests at the Massachusetts Agricultural Experiment Station it was found that velvet-bean feed, if sufficiently dry to prevent decomposition, may comprise some 20 per cent of the grain ration, mixed together with 30 per cent of oats, 40 per cent of cracked corn, and 10 per cent of wheat bran.

INSECTS.

The only insect which causes serious injury to the velvet bean is the larva of the velvet-bean caterpillar, which feeds on the leaves. The moth of this caterpillar does not winter in northern or central Florida, but flies northward each summer from the southern end of the peninsula, or perhaps from Cuba. This insect seldom appears farther north than southern Georgia. At times the damage is very severe, and often all of the plants in large fields are entirely defoliated. The moths usually make their first appearance in July in southern Florida, during August in central Florida, and during the last part of August or first part of September in the northern part of that State and in southern Georgia.

As little damage is done for the first 10 days or two weeks after the appearance of the moth, this insect should give no trouble when the early-maturing varieties of velvet beans are planted, as they will usually mature by the middle of September in northern Florida and southern Georgia.

The Florida Agricultural Experiment Station has been successful in combating this pest by dusting the vines with arsenate of lead or zinc arsenite 10 or 12 days after the first appearance of the moth. For this purpose 3 pounds of powdered arsenate of lead or zinc arsenite mixed with 12 pounds of air-slaked lime is sufficient for an acre. When this quantity is used there is no danger from poisoning the stock when pastured in the field, especially after one or two rains.

According to the Bureau of Entomology this insect is generally distributed throughout tropical America and has also been recorded as appearing in Mexico, Costa Rica, Panama, and Cuba.

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